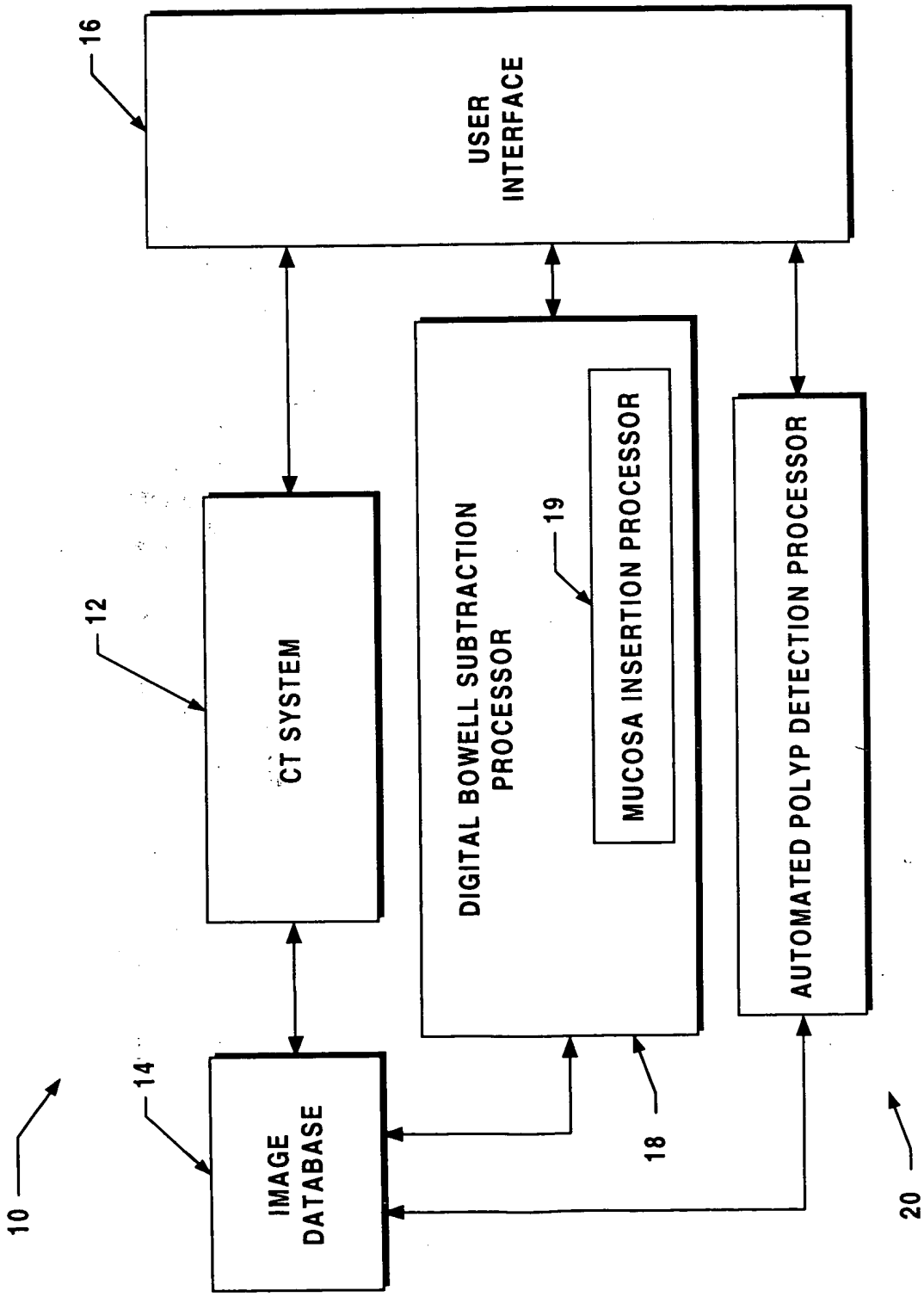

16
USER INTERFACE
12
CT SYSTEM
DIGITAL BOWELL SUBTRACTION PROCESSOR
19
MUCOSA INSERTION PROCESSOR
AUTOMATED POLYP DETECTION PROCESSOR
14
IMAGE DATABASE
10
18
20

FIG. 1

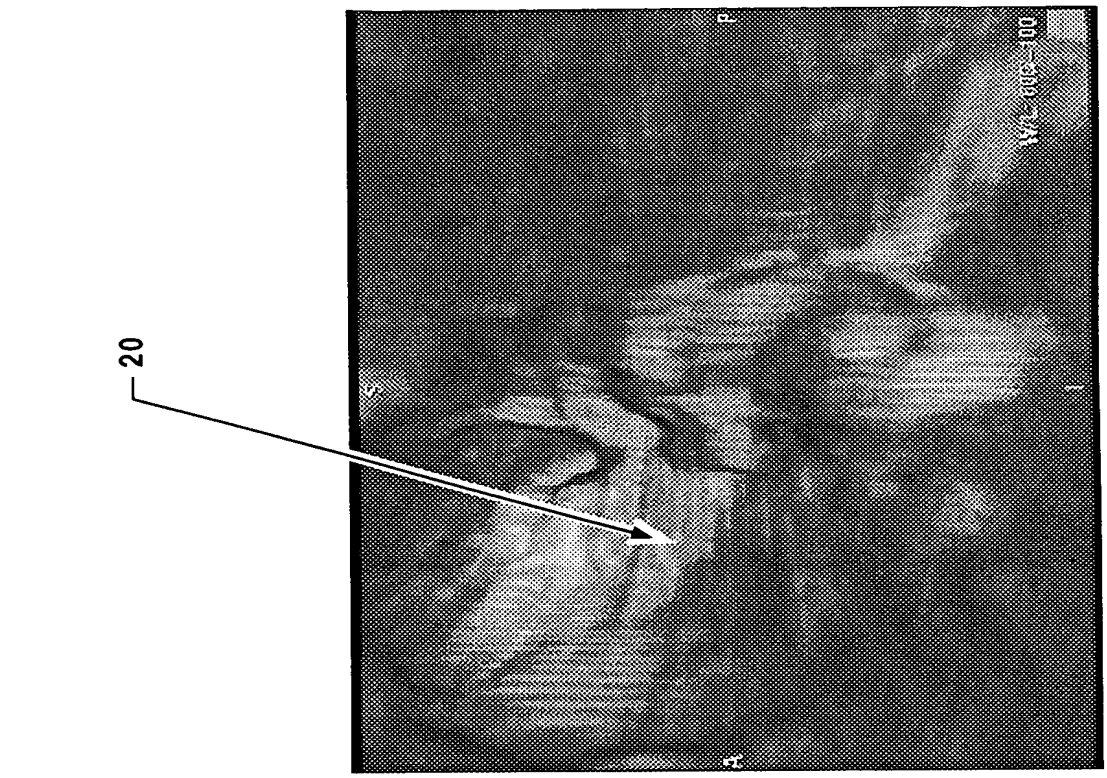


FIG. 1B

19B

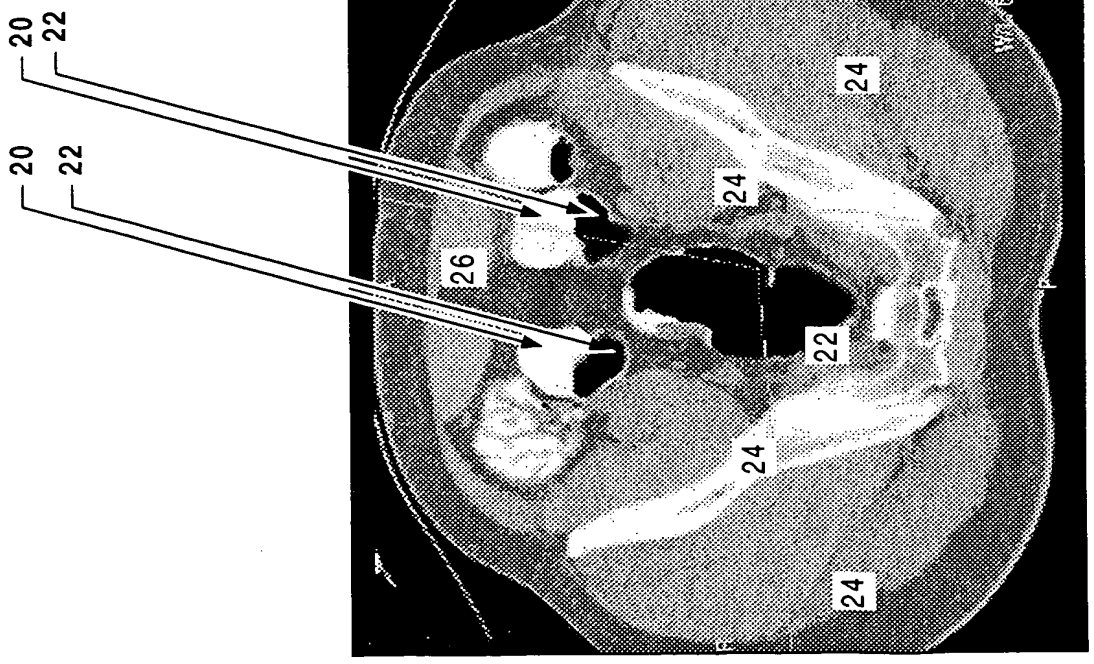
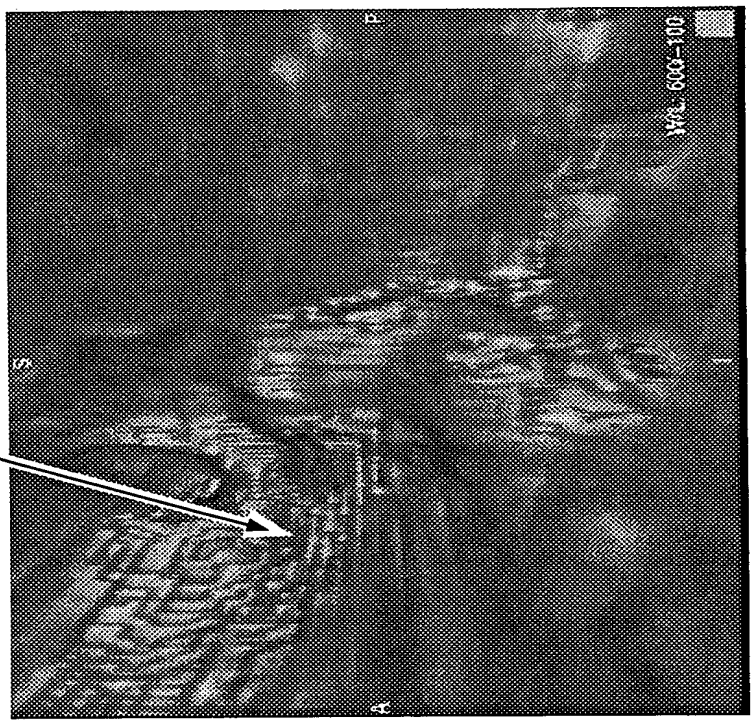


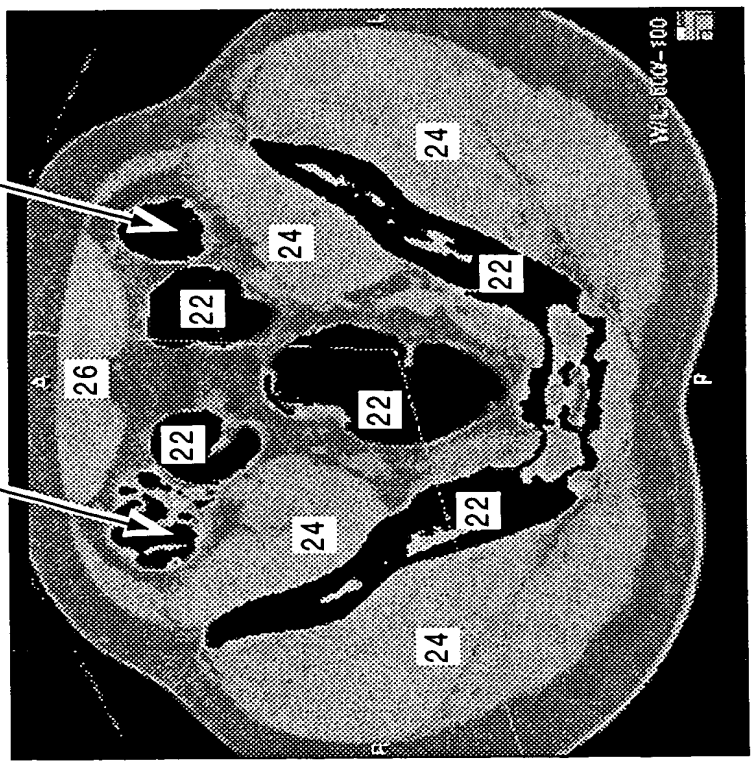
FIG. 1A

19A



19D

FIG. 1D



19C

FIG. 1C

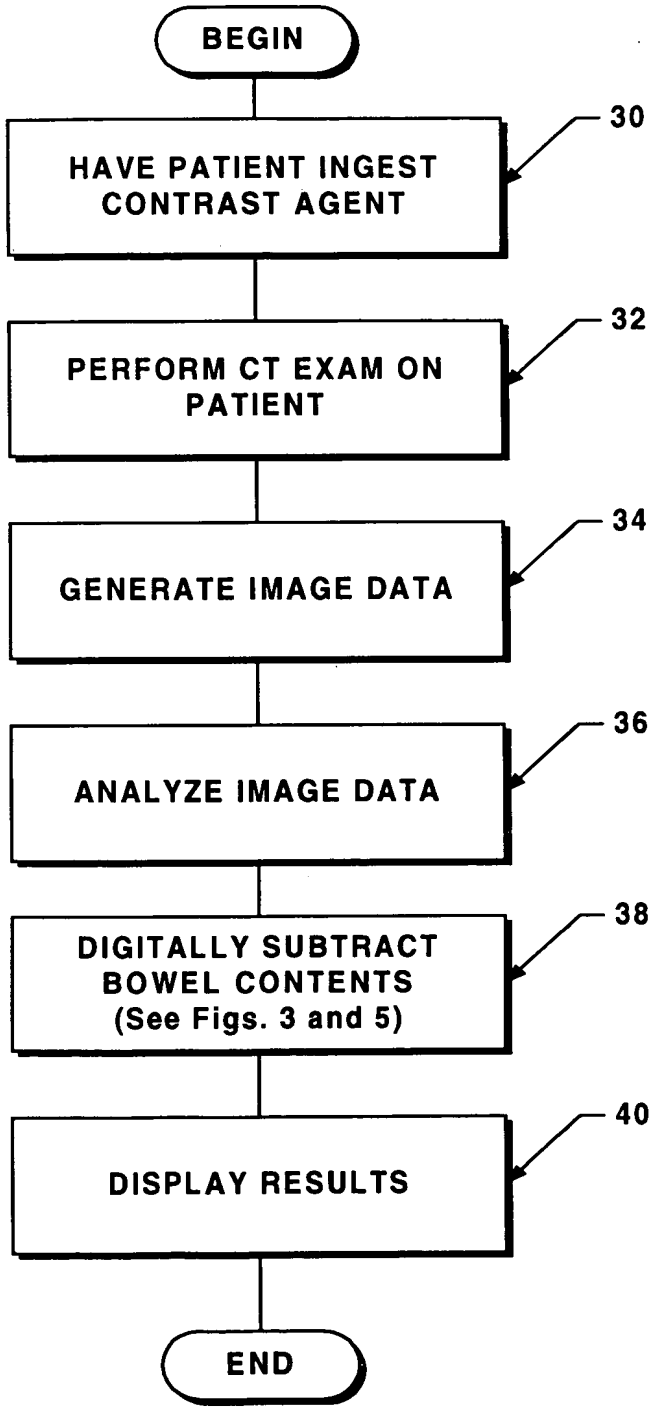

BEGIN
HAVE PATIENT INGEST CONTRAST AGENT
30
PERFORM CT EXAM ON PATIENT
32
GENERATE IMAGE DATA
34
ANALYZE IMAGE DATA
36
DIGITALLY SUBTRACT BOWEL CONTENTS (See Figs. 3 and 5)
38
DISPLAY RESULTS
40
END

FIG. 2

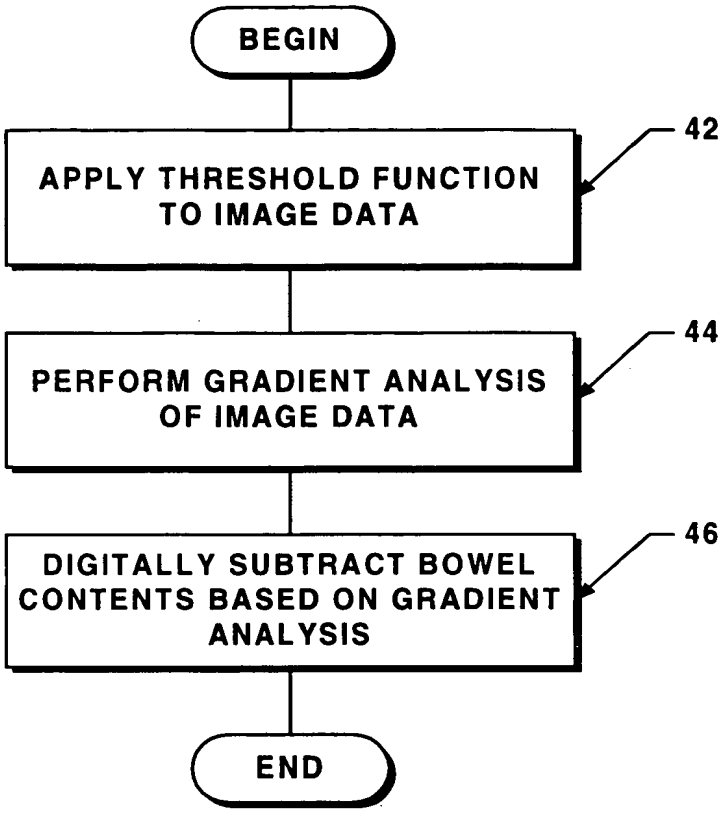

BEGIN
APPLY THRESHOLD FUNCTION TO IMAGE DATA
42
PERFORM GRADIENT ANALYSIS OF IMAGE DATA
44
DIGITALLY SUBTRACT BOWEL CONTENTS BASED ON GRADIENT ANALYSIS
46
END

FIG. 3

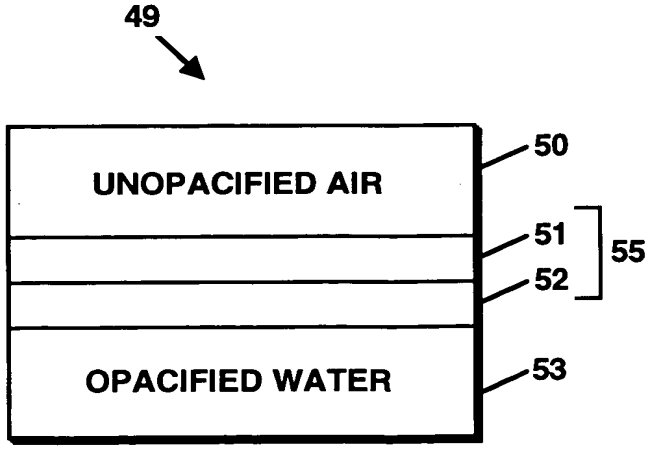

49
UNOPACIFIED AIR
50
51
52
55
OPACIFIED WATER
53

FIG. 4

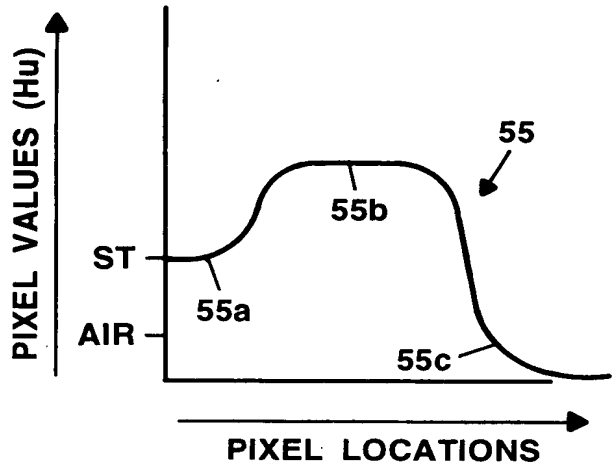


FIG. 4A

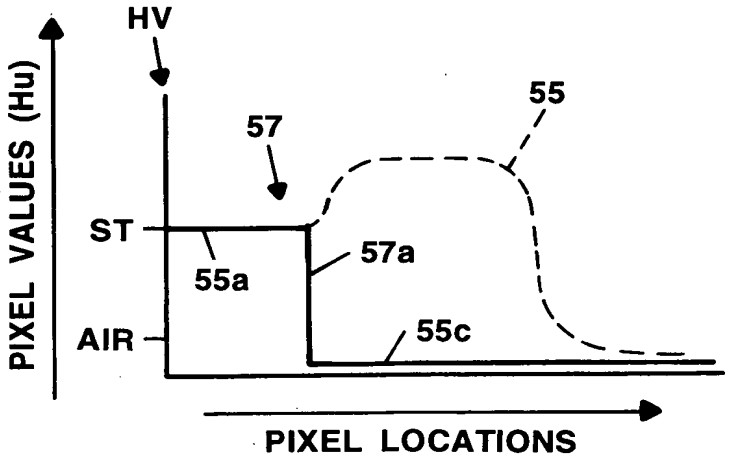


FIG. 4B

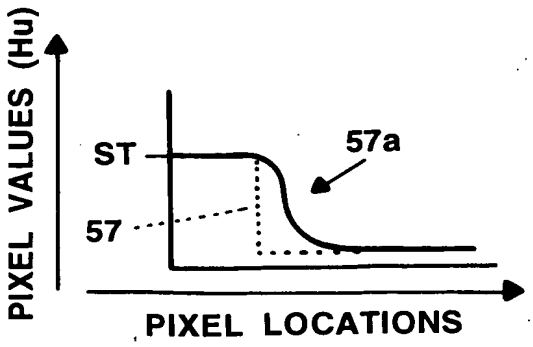


FIG. 4C

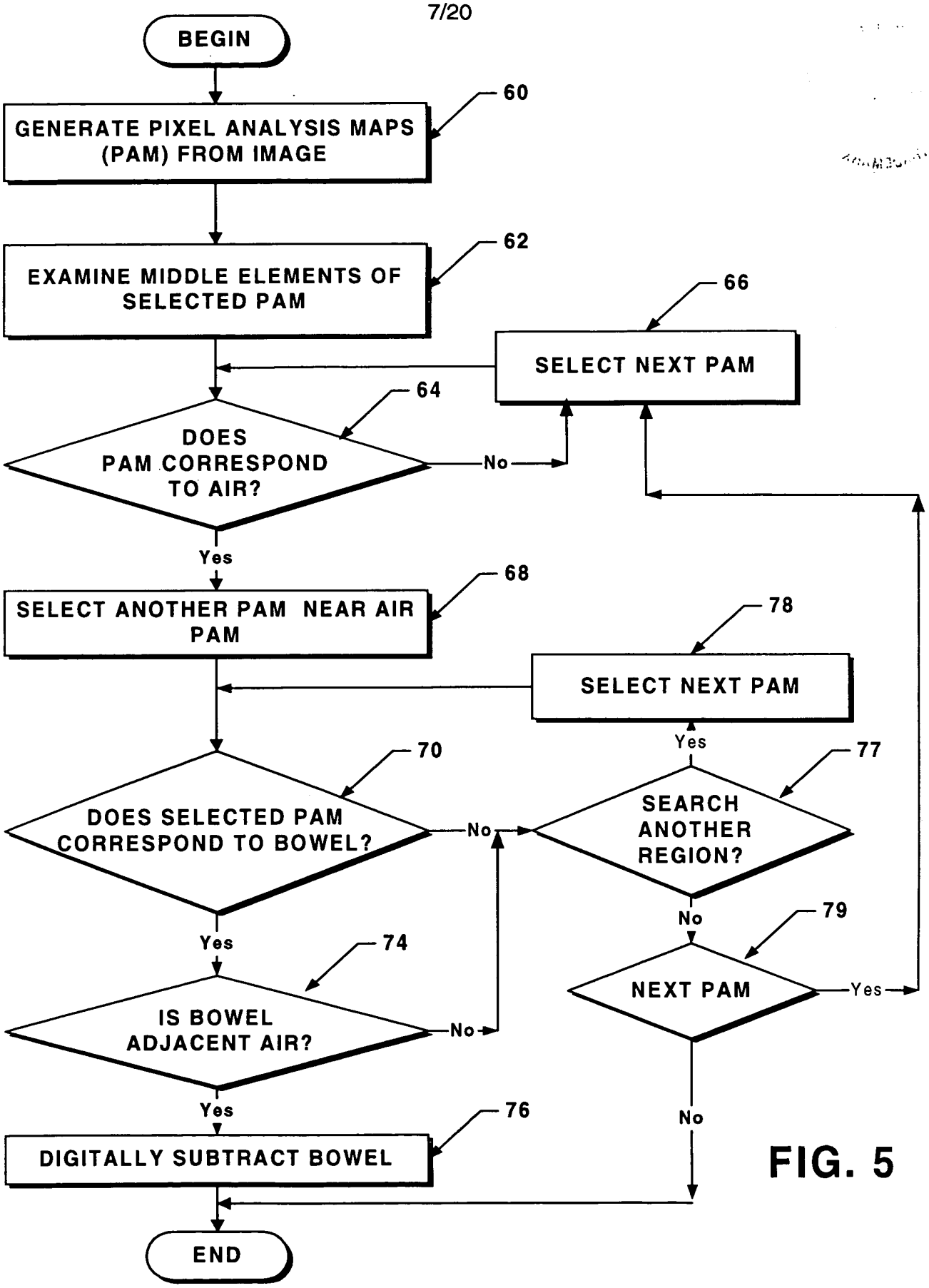

BEGIN
GENERATE PIXEL ANALYSIS MAPS (PAM) FROM IMAGE
60
EXAMINE MIDDLE ELEMENTS OF SELECTED PAM
62
SELECT NEXT PAM
66
DOES PAM CORRESPOND TO AIR?
64
No
Yes
SELECT ANOTHER PAM NEAR AIR PAM
68
SELECT NEXT PAM
78
Yes
DOES SELECTED PAM CORRESPOND TO BOWEL?
70
No
SEARCH ANOTHER REGION?
77
No
79
NEXT PAM
Yes
Yes
IS BOWEL ADJACENT AIR?
74
No
Yes
No
DIGITALLY SUBTRACT BOWEL
76
END

FIG. 5

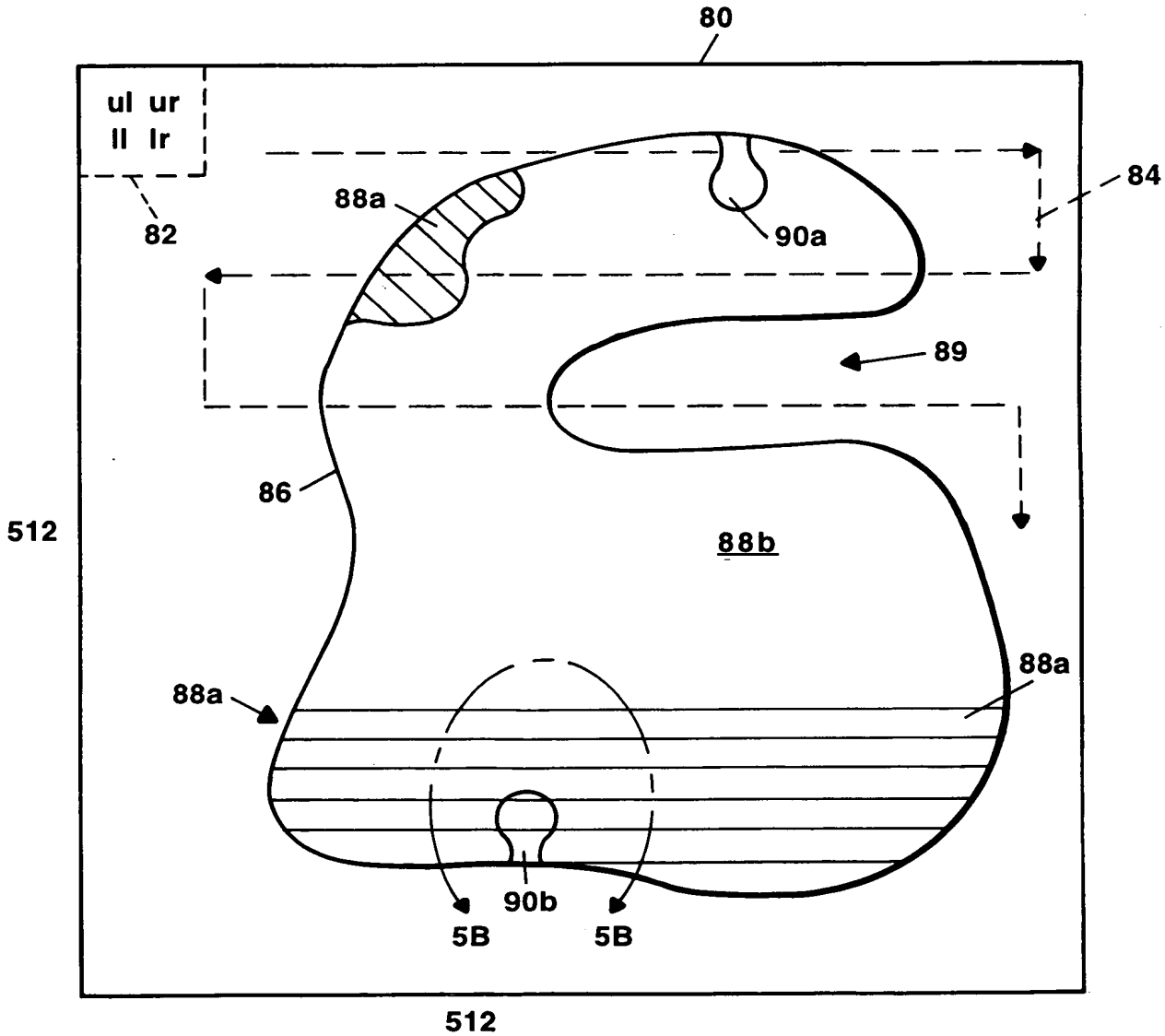


FIG. 5A

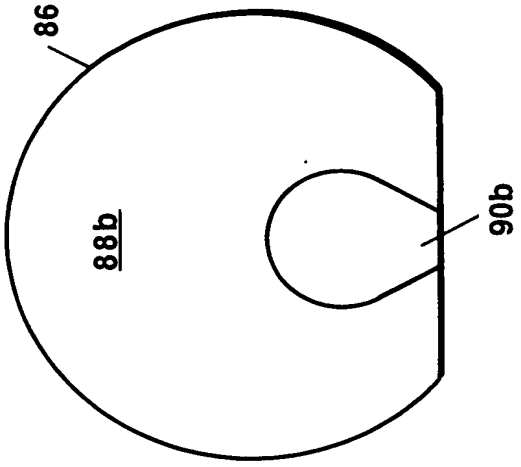


FIG. 5C

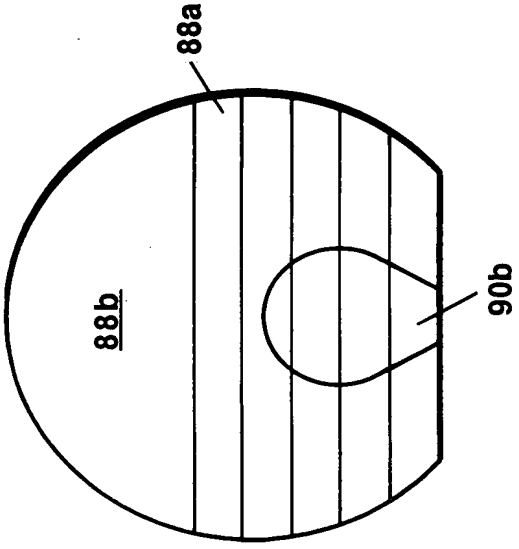


FIG. 5B

82'

NW			Nl		Nr		NE
	nw x	NL x	Nl x	Nr X	nR x	ne x	
	Uw x	UL o	Ul o	Ur o	UR o	Ue x	
uW	uw x	uL o	ul 91a	ur 91b	uR o	ue x	uE
lW	lw x	lL o	ll 91c	lr 91d	lR o	le x	lE
	Lw x	LL o	Ll o	Lr o	LR o	Le x	
SW			Sl	Sr			SE
-							

92

FIG. 5D

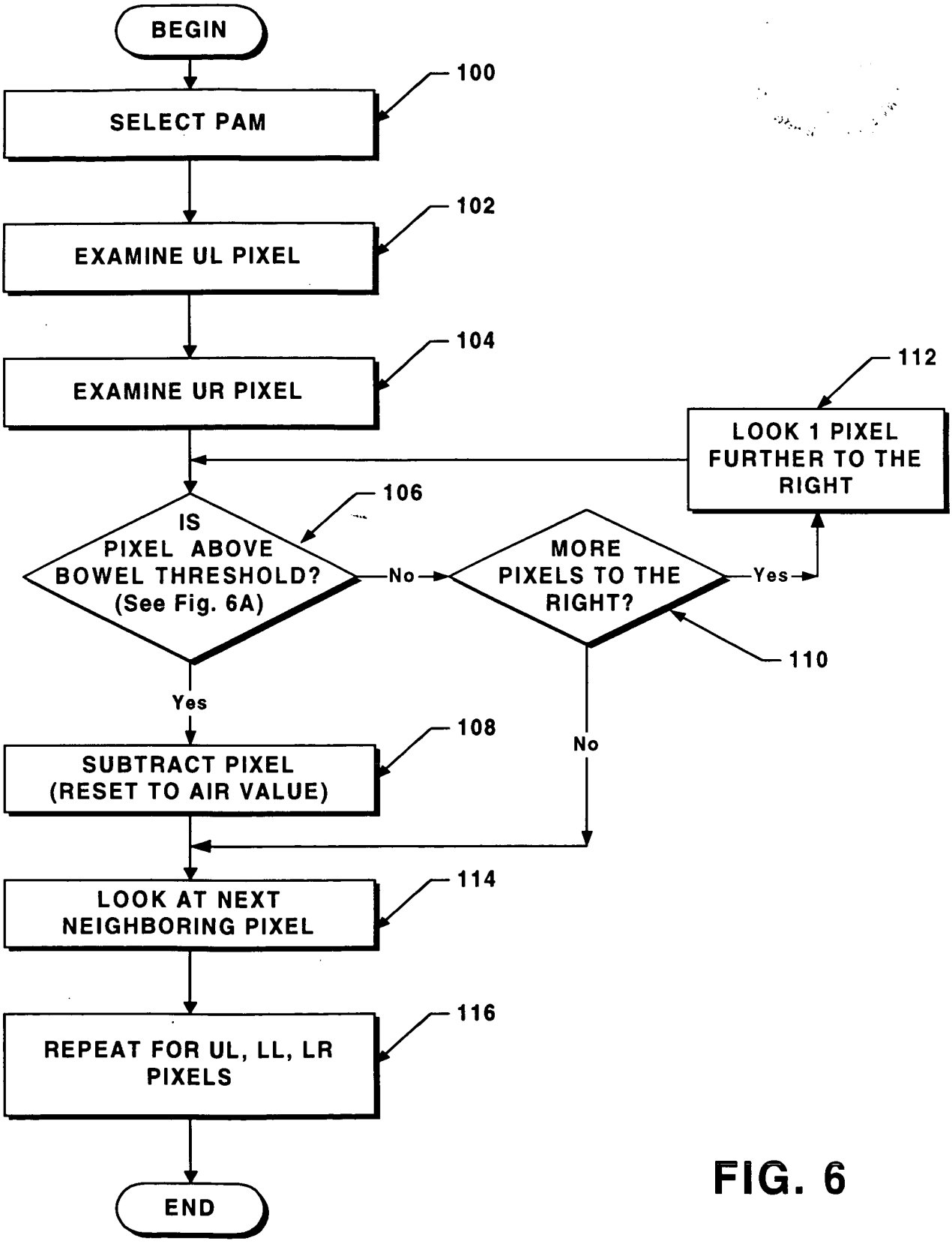

BEGIN
100
SELECT PAM
102
EXAMINE UL PIXEL
104
EXAMINE UR PIXEL
112
LOOK 1 PIXEL FURTHER TO THE RIGHT
106
IS PIXEL ABOVE BOWEL THRESHOLD? (See Fig. 6A)
No
MORE PIXELS TO THE RIGHT?
Yes
110
Yes
No
108
SUBTRACT PIXEL (RESET TO AIR VALUE)
114
LOOK AT NEXT NEIGHBORING PIXEL
116
REPEAT FOR UL, LL, LR PIXELS
END

FIG. 6

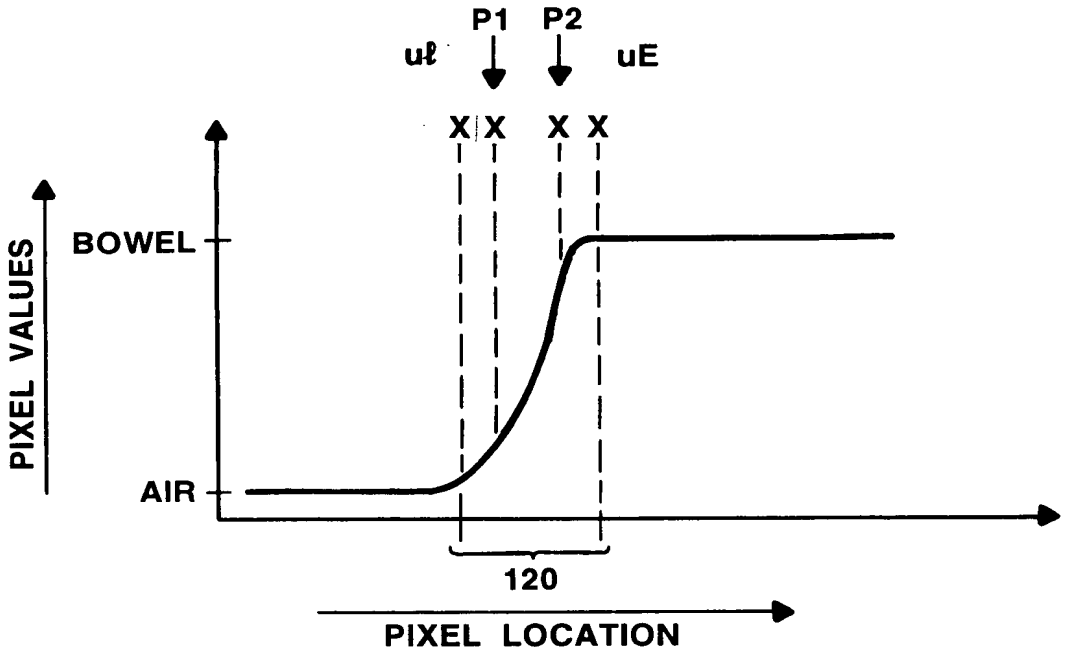

uℓ
P1
P2
uE
X X X X
PIXEL VALUES
BOWEL
AIR
120
PIXEL LOCATION

FIG. 6A

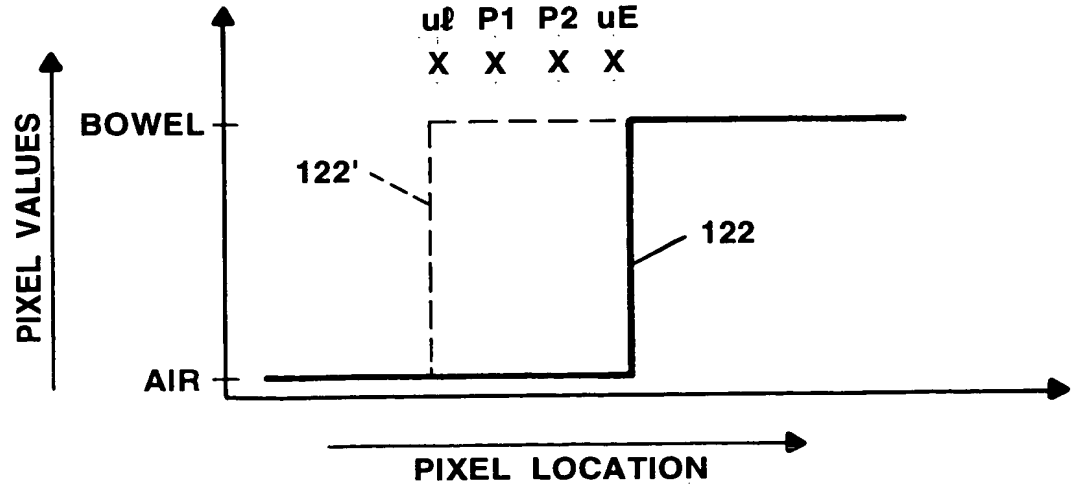

uℓ P1 P2 uE
X X X X
PIXEL VALUES
BOWEL
122'
122
AIR
PIXEL LOCATION

FIG. 6B

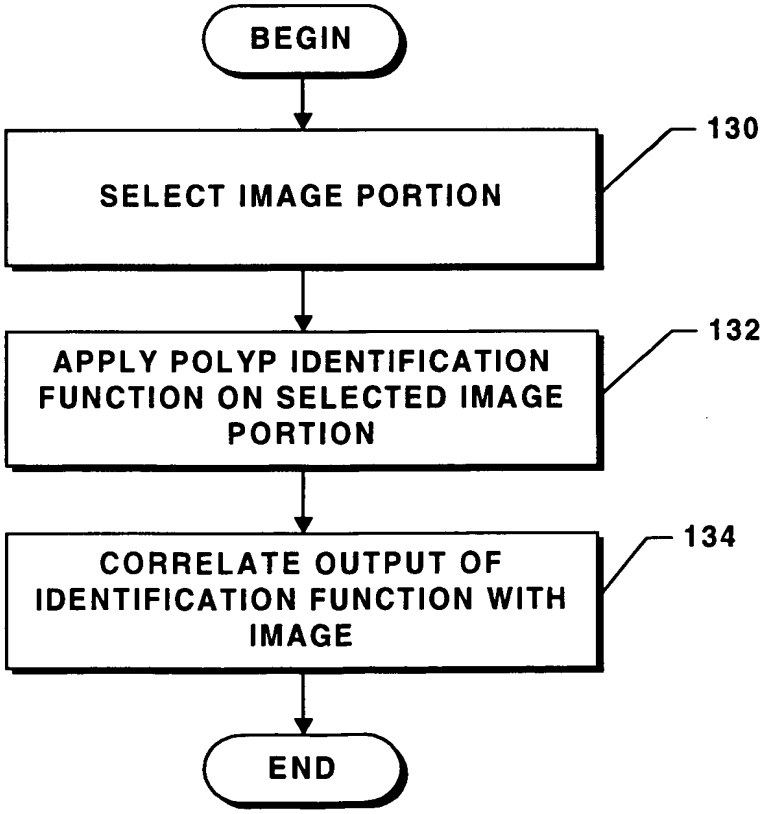

BEGIN
SELECT IMAGE PORTION
130
APPLY POLYP IDENTIFICATION FUNCTION ON SELECTED IMAGE PORTION
132
CORRELATE OUTPUT OF IDENTIFICATION FUNCTION WITH IMAGE
134
END

FIG. 7

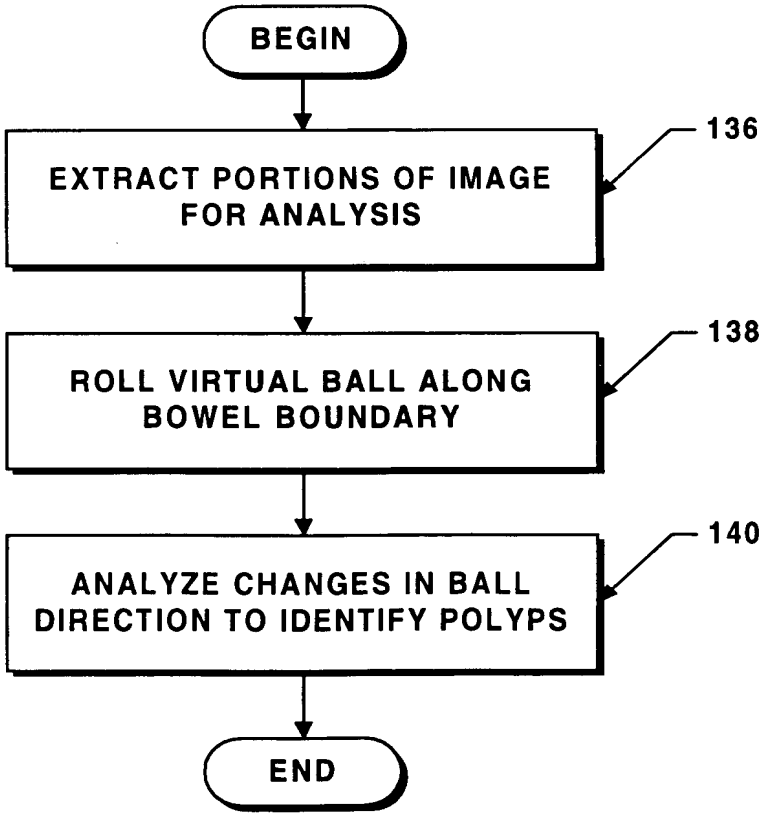

BEGIN
EXTRACT PORTIONS OF IMAGE FOR ANALYSIS
136
ROLL VIRTUAL BALL ALONG BOWEL BOUNDARY
138
ANALYZE CHANGES IN BALL DIRECTION TO IDENTIFY POLYPS
140
END

FIG. 8

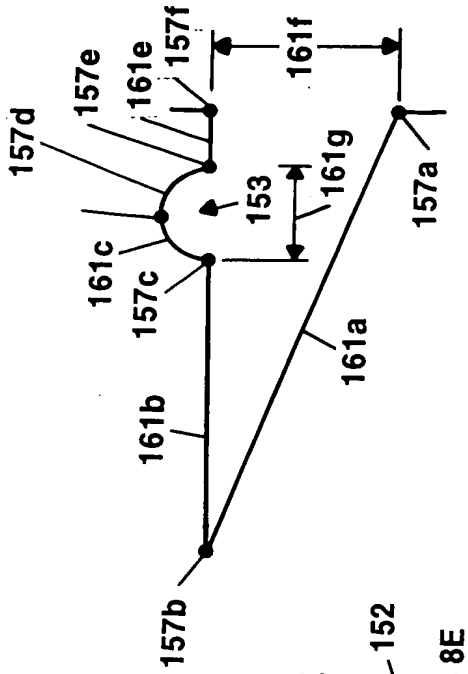


FIG. 8E

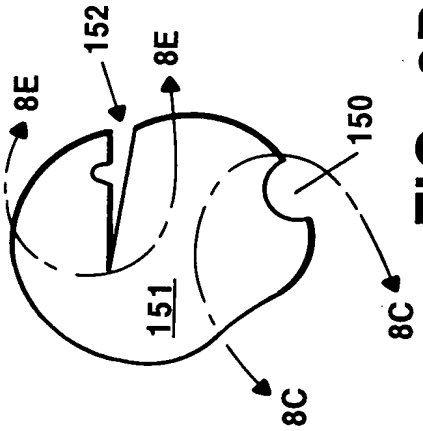


FIG. 8B

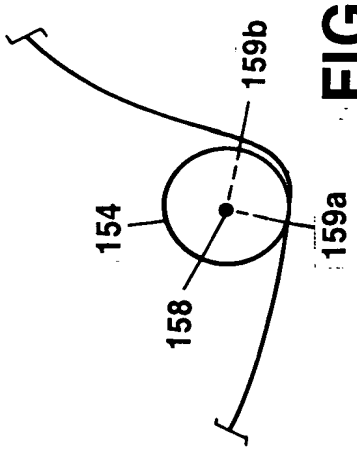


FIG. 8D

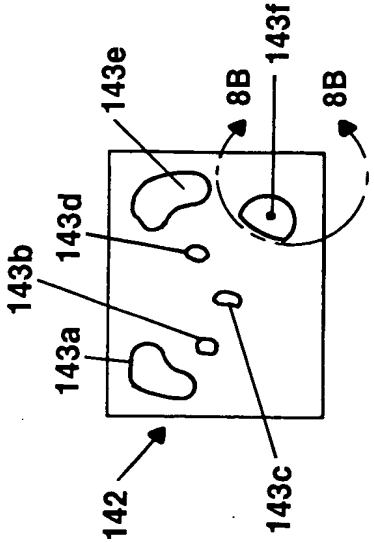


FIG. 8A

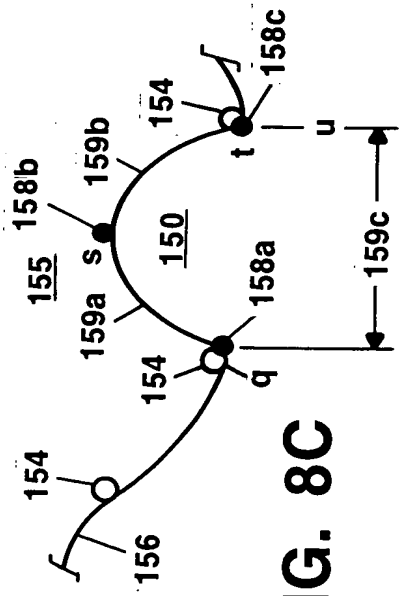


FIG. 8C

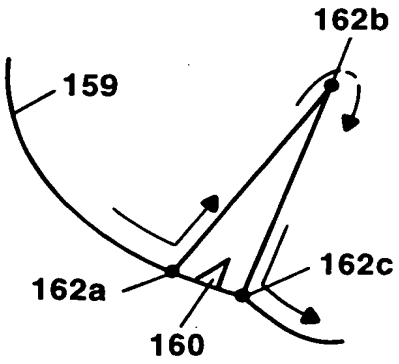


FIG. 8F

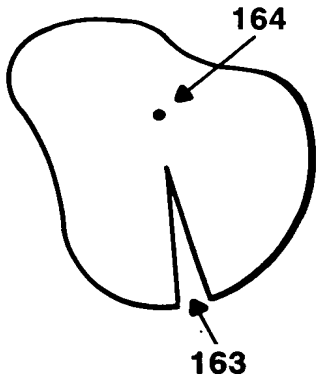


FIG. 8G

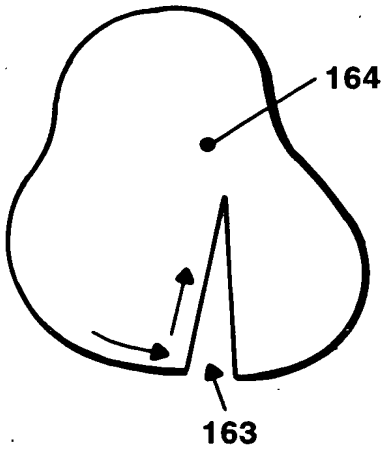


FIG. 8H

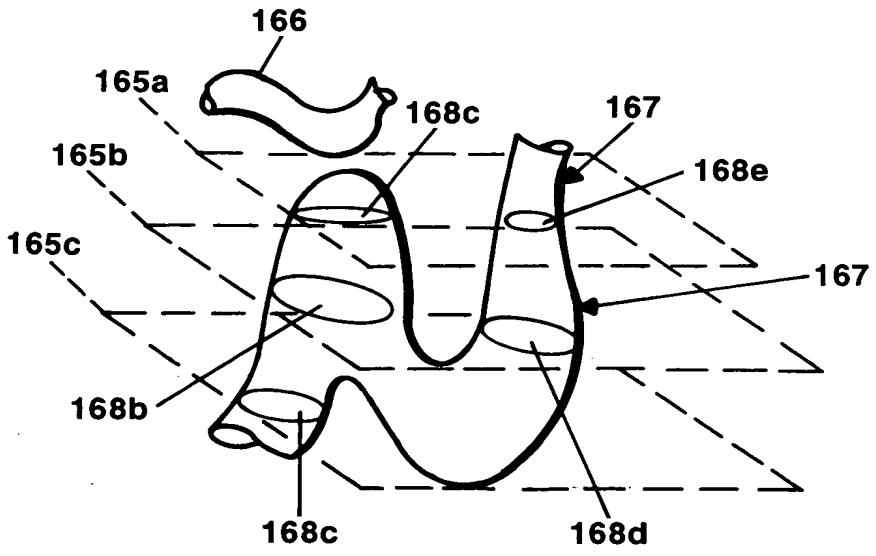


FIG. 8I

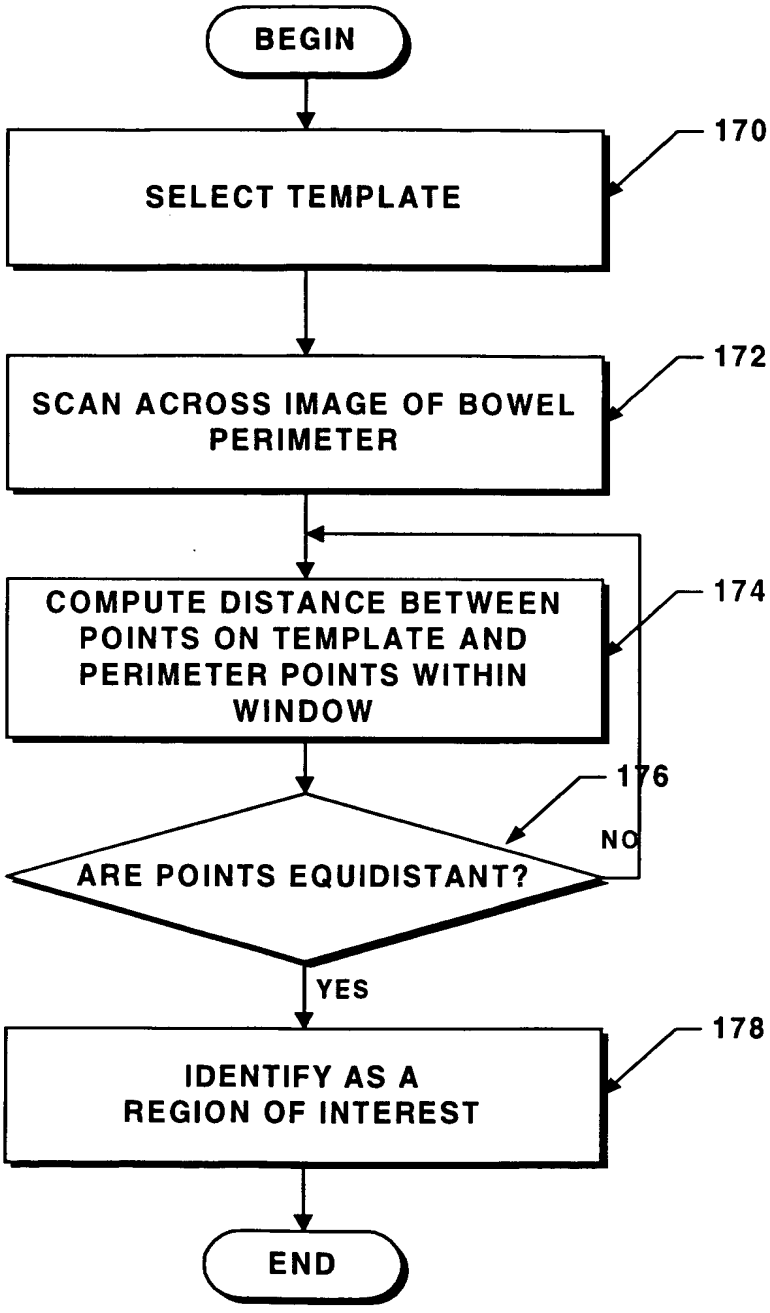

BEGIN
SELECT TEMPLATE
170
SCAN ACROSS IMAGE OF BOWEL PERIMETER
172
COMPUTE DISTANCE BETWEEN POINTS ON TEMPLATE AND PERIMETER POINTS WITHIN WINDOW
174
ARE POINTS EQUIDISTANT?
176
NO
YES
IDENTIFY AS A REGION OF INTEREST
178
END

FIG. 9

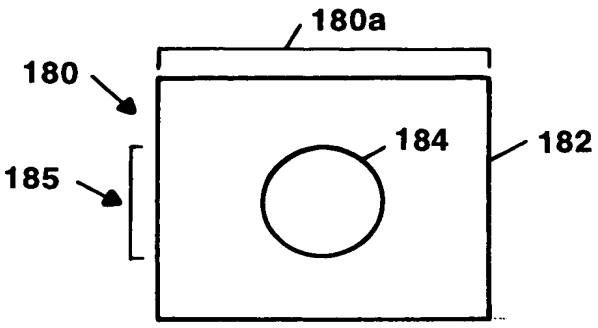


FIG. 9A

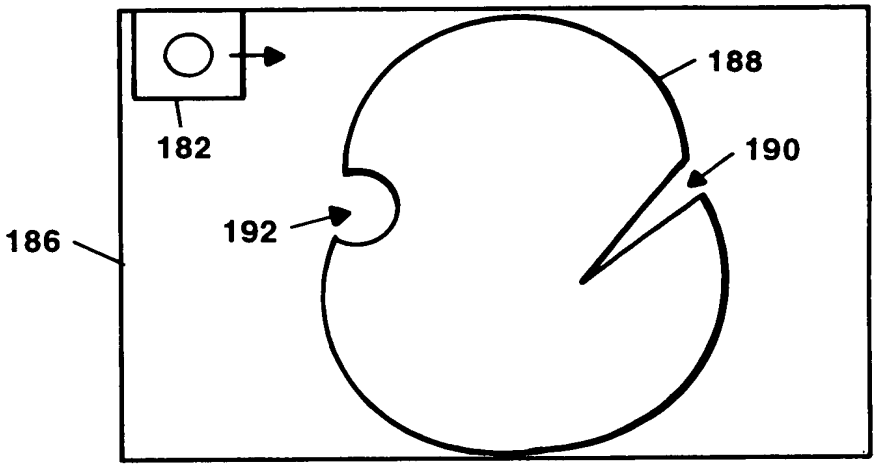


FIG. 9B

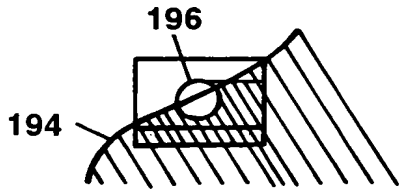


FIG. 9C

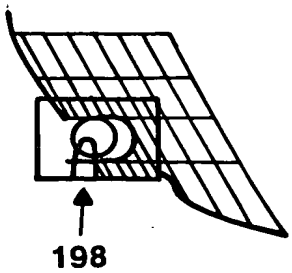


FIG. 9D

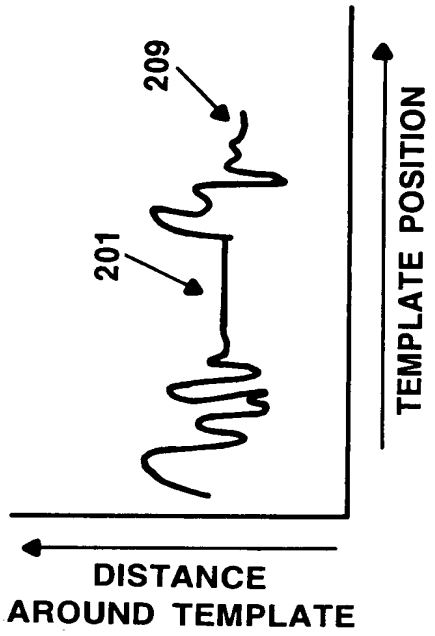
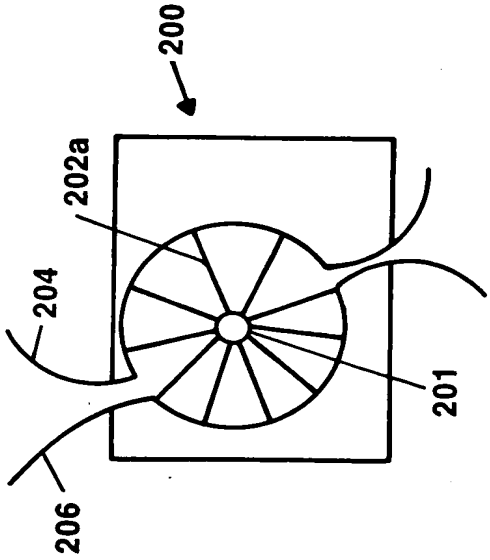


FIG. 9G



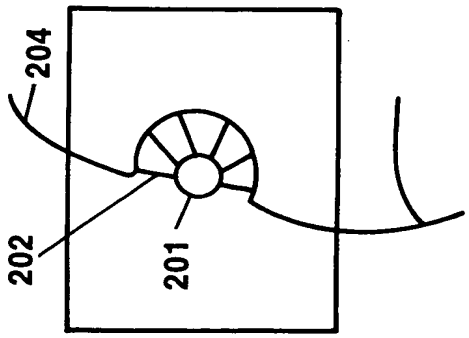


FIG. 9E

FIG. 9F